large black rhombs which may be confluent into a zigzag band; a lateral series of smaller black spots; a Λ- or A-shaped black marking on the top of the head, the point between the eyes; a black streak on each side of the head, from above the nostril to above the last labial shield; lower parts uniform yellowish or pale green; end of tail black or blackish.

Total length 630 mm.; tail 85.

Several specimens were obtained by Mr. R. B. Woosnam on the east side of Ruwenzori, between 6000 and 6500 feet altitude. This fine snake may sometimes be seen coiled up round the stem of elephant-grass 10 feet above the ground. It is viviparous.

This species is well characterized by its smaller eye, its sharp canthus rostralis, and its smooth or nearly smooth gular scales.

IX.—*Alternation of Generations, Metamorphosis, and Direct Development.* By W. Wedekind *.

In my previous writings on the subject of parthenogenesis I have already pointed out that, in my opinion, so-called asexual reproduction was everywhere the primitive method, and that it is only in the course of phyletic development, through the series—segment, bud, spore, and female and male partheno-ovum,—that at last the ovum needing fertilization and the sperm belonging to it have arisen therefrom. It follows, therefore, that all organisms with sexual reproduction must be derived from asexual ancestors. According to the biogenetic law of recapitulation this phylogeny must also very generally have been repeated in the ontogeny, and I would, moreover, venture to assume that in earlier epochs the course of the entire ontogeny was not yet by any means so rapid as it usually is to-day. It therefore follows from our theory that the ancestral stage of asexual reproduction must formerly have still been displayed in the development of each individual, and that it was only gradually that it became more and more suppressed.

According to this interpretation, then, in the first instance from every fertilized ovum at least an asexual generation must again have developed, and only from this has there arisen once more the ultimate form with sexual reproduction.

* Translated by E. E. Austen from the 'Zoologischer Anzeiger,' Bd. xxix. Nos. 25/26 (March 6, 1906), pp. 790–795.

In other words, alternation of generations was universally the most primitive form of ontogeny, and consequently it is not of merely secondary origin through selection, but, on the contrary, it has persisted only here and there. Thus, on the basis of the theory of descent and the biogenetic law of recapitulation we arrive at this simple explanation: —*alternation of generations is* (nothing more than) *the ontogenetic repetition of the phylogenetic progressive development from lower organisms with asexual reproduction into higher species with dissociated sexual products.* In this way, too, the different varieties (heterogony &c.) are easily intelligible.

When, in consequence of continued acceleration of the ontogeny, the first asexual generation produces, instead of the previous numerous progeny, only a single offspring, and when, moreover, this single descendant no longer severs itself from the mother, but proceeds from it more or less continuously, the ontogeny assumes the form of *metamorphosis.* The latter has therefore arisen from alternation of generations by a process of constant abridgement; and thus we can shortly define metamorphosis as *a curtailed alternation of generations.*

In all cases, then, it is only through continuous acceleration of the ontogeny that *direct development*, as we find it to-day, has arisen from alternation of generations and metamorphosis. Direct development is everywhere the secondary process, which in consequence of its great rapidity is also well-nigh incomprehensible, whereas it is much easier for us to picture to ourselves phylogeny, which is a million times slower, and also an earlier and less rapid ontogeny.

In this way, therefore, alternation of generations and metamorphosis lose all that was previously inexplicable and become easily intelligible to us by means of the theory of descent, when we regard them simply as ontogenetic recapitulations of the development of the species. They are no new processes, which have only arisen at a later date, but, on the contrary, the oldest forms of ontogeny, which, on a further development of the organic world, should it chance to occur later on, will tend towards direct development, but have not originated from the latter. Their occurrence to-day represents only the last remnants of earlier and probably much more widely diffused conditions, just as is the case as regards modern parthenogenesis.

A material advantage of this mode of interpretation, therefore, is that it is nowhere necessary for us to assume the existence of a *cœnogenesis,* with retarded and altered development. Ontogeny consequently makes no detours, but merely

goes on developing continually in a tachygenesis which becomes constantly more and more accelerated.

Moreover, up to the present it has nowhere been shown that the retardation of ontogeny is only secondary. Fritz Müller, too, who is much quoted to this end, certainly brings forward in his well-known memoir many an instance of tachygenesis, and also maintains that development is frequently falsified by the struggle for existence which the free-living larvæ had to undergo; he remarks that this point needs no further elucidation, since it is self-evident, &c., &c. The author in question states that it is easy to understand how even a direct course of development may again be transformed through the struggle for existence into a development with metamorphosis. But in no passage of his work does Müller adduce any *fact* whatever in favour of this assertion, any more than the point has previously been proved by other authors. To me, too, that nature in so many instances should have made such a retrograde step is anything but "self-evident" and "easy to understand"; and still less can I picture to myself the *inner causes* of such a process, especially since I have long ago abandoned the pious belief of my scientific childhood in the omnipotence of selection.

The "utility" also of such a retarded development is absolutely incomprehensible to me. For what have butterflies, for instance, to gain from the fact that, with a more protracted caterpillar life, they are so much the longer exposed to the danger of being devoured before they reach the final goal of their development? Or wherein are they benefited by previously as caterpillars eating up the very plants upon which they subsequently want to live as butterflies?

And so probably in all cases the harmfulness of a slow development can be demonstrated at least equally as well as the advantage; and even when the latter is really present, it still need not on that account be an originating cause, but is, as I interpret it, merely the external stimulus, which, in the case of the species in question, has led to the longer ontogeny persisting until the present day.

In almost every instance, however, a species must derive the greatest advantage from completing its developmental stage as quickly as possible, in order afterwards to continue to live quite a long time as an adult animal. Among insects I need only remind the reader of the highly organized Hymenoptera, of which the metamorphosis is no longer so "complete" as is that of the beetles, butterflies and moths, &c. The metamorphosis, *e. g.* in the case of the bees, which, in contrast to that exhibited by the other orders referred to,

has already undergone considerable reduction, surely bears witness to the general striving after a constantly shorter tachygeny, although, from internal causes of which we are still ignorant, in the case of many lower animals this has not yet advanced so far as direct development.

As the weightiest objection to my interpretation I shall naturally again have to encounter the views on phylogeny which are held to-day. In the case of the lowest orders among the Tunicata we find direct development: consequently the alternation of generations in the higher Tunicata, which are evidently derived from the former, can only be a secondary acquisition. And likewise in the case also of the higher insects, since they are said to be derived from their lower relations which have direct development, "complete" metamorphosis can only be of secondary origin.

In opposition to this line of argument, however, I would call attention to the self-evident truth that in no class of the animal kingdom does there obtain a relation of direct descent between its existing higher and lower orders, and to this rule the Tunicates and Insects form no exceptions. The ancestral form of the Tunicata was consequently not in all points identical with the Appendicularidæ of the present day, but must at least have had a divergent attribute in common with the higher Tunicates. And thus we may naturally just as well imagine these Archi-Tunicates as in other respects entirely similar to the Appendicularidæ, but with asexual reproduction. A portion of these, the present Appendicularidæ, then branched off to one side quite early, and displayed a very rapid and precocious transition to sexuality, so that they, perhaps even in consequence of this over-speedy advance to sexual life, subsequently remained stationary at a lower stage of the development of the phylum. On the other hand the majority, while retaining asexual reproduction for a longer period, continued perhaps on that account slowly but nevertheless surely to make progress in their phylogenetic development, until in their case also a conclusion was reached with the attainment of sexuality in the higher orders. Moreover, this phylogeny of varying length was subsequently retained in the ontogeny also. Since no other material difference any longer existed between the ancestral form with asexual and the present Appendicularidæ with sexual reproduction, ontogeny, too, was easily able to proceed to direct development, while the less rapid phylogeny of the higher orders has left its traces in their ontogeny even at the present day.

Similarly, too, the "typical archi-normal Insect" was, in

my opinion, (not provided with wings and) not dicœcious. This ancestral form must rather have been represented by somewhat worm-like creatures, which (just as, indeed, many worms still do) reproduced themselves asexually and gave rise polyphyletically to the different orders. From these, too, there then very early branched off a portion, which likewise again, precisely because it precociously developed the condition of separate sexes, also remained stationary at the lowest stage; while the remainder, again in consequence of longer retention of the asexual mode of reproduction, had time to undergo further phyletic improvement, and only at the conclusion of their various orthogenies also became parthenogenetic or dicœcious as the case may be. Here also the phylogeny of varying length is then reflected again in a reduced or "complete" metamorphosis, while the latter itself represents no more than the "welding together" of the two primitive generations.

It appears exactly as though the transition to sexual reproduction is also universally connected with a pause in the orthogeny, so that, if the latter takes place rapidly or prematurely, the whole of the rest of the organization also generally remains stationary at a lower stage, while the slower attainment of sexuality in the phylogeny likewise allows time for a higher orthogeny. The one condition directly entails the other, and I would term this phenomenon shortly the *law of precocity* (*prematurity*). A more rapid ontogeny, a direct development, consequently only shows that the earliest stages of the asexual ancestors were already abandoned at a very early period, but not that they had been altogether wanting; and it may also very well be that traces of them are still to be discovered even at the present time.

Naturally my theory is not capable of direct proof, any more than is the opposite view. I think, however, that my theory is simpler and more natural, since by means of it, indeed, we at once get rid of the entire cænogeny, and need only imagine the ontogeny as having been accelerated, but not as having subsequently been altered, by side influences.

In this way also we should surely find less difficulty in understanding the manifold transitions, which still frequently occur especially between alternation of generations and metamorphosis, and with regard to which we may be in much doubt as to whether we are still confronted with a reduced alternation of generations or have before us an already commencing metamorphosis. They are all just gradations of one and the same phenomenon, which pass without a break one into the other, and with which hitherto the majority

of authors have not known how to deal correctly. Brandes alone, in his new edition of Leuckart's work on 'Parasites,' speaks on one occasion of a "masked" alternation of generations; but otherwise such intermediate stages are always interpreted as "commencing" alternation of generations. But still it is by no means quite clear how such a view can be taken. There certainly can be no question of orthogeny, and, on the other hand, neither can any value whatever be attributed to such "beginnings" from the point of view of selection. Thus it is consequently in all probability more correct to regard them simply as purposeless remnants, and so to consider them as we do the rudimentary organs, which, indeed, were equally conundrums before Darwin's time. In the embryological works of the last few years will be found the description of many a phenomenon which from this point of view would be much more readily intelligible.

The regenerative faculty, too, is thus perhaps capable of being interpreted simply as the rudiment of an earlier asexual mode of reproduction. The ability to produce from their asexual cell-material a new and distinct individual has gradually been lost by the higher animals (and this is how I account for metamorphosis also); but at least they have still retained the power of continually bringing the old individual up to its normal condition. This, then, probably also explains why it is precisely organisms with undiminished asexual reproduction (thus, the plants in an especial degree) that do not regenerate; and hyper-regeneration, too, is surely easy to understand when we regard it as a more powerful remnant of an earlier asexual reproduction.

It may be that thoughts like these have already occurred to one naturalist or another, and that it was only Tunicates, Insects, &c., that hitherto have always led to their being abandoned again. On that account I have already dealt with this main objection in the present paper, while I must defer the further development of my theory in fuller detail until somewhat later, in connexion with my thesis on parthenogenesis and arbitrary determination of sex in the higher animals. For it all hangs together, one thing follows from the other, and everything rests upon a mutual basis. The entire development of the organic world is to my mind a purely orthogenetic process, consisting in continually advancing "sexual dissociation" of the primitively latent-hermaphrodite (so-called asexual) original condition. Without such a "sexuality" of the organic world, a natural force, therefore, which has hitherto been disregarded, we shall, in my opinion, be unable to furnish a complete explanation of

organic life; but with a working hypothesis of this kind we at least advance a step or two further.

Just as little as we can explain the magneto-electric phenomena by means of mechanics alone, so do we find that these two no longer suffice for the organic phenomena; on the contrary, in their place also we must now assume the existence of a special form of energy, upon which, from its most conspicuous quality, I bestow the designation "sexuality." In this force there is, of course, just as little of the supernatural as in the other forces of nature. And that it is likewise already capable of being expressed in figures and is subject to mathematical treatment I shall shortly show elsewhere in a paper on the mathematical equations of the partheno-ova and their fertilization.

X.—*Natural History Notes from the R.I.M.S. Ship 'Investigator,' Capt. T. H. Heming, R.N., commanding.*—Series III., No. 13. *Two new Barnacles dredged in* 1905–6. By N. Annandale, D.Sc., Indian Museum, Calcutta.

Genus Dichelaspis.

Dichelaspis transversa, sp. n. (Figs. 1, 1 *a*.)

Capitulum bullate, with the orifice on the upper surface and almost parallel to the base, with a well-defined lobular projection on each side of the orifice at its upper extremity, with three complete valves and traces of a second pair. *Scuta* linear, sinuous or curved, short, uneleft; *carina* narrow, very short, almost straight, somewhat variable, without either a disk or a fork at its base; terga totally uncalcified, represented by a pair of amorphous chitinous patches. *Pedunele* stout, constricted above, as long as or longer than the capitulum.

Mandible with five teeth; the four innermost short, simple, subequal; the outermost large, sharply pointed, widely separated from the others.

Penis longer than body, very stout, constricted distally and ending in a bunch of fine, curved, filiform processes; the whole organ densely covered with rings of minute, laterally flattened, triangular, chitinous spines, which have a flattened depressed base; a few larger chitinous structures with a subconical base and a recurved distal point scattered, with some short bristles, near the distal extremity. Anal ap-